Cost–Performance Analysis of TWX-Mediated Interlibrary Loans in a Medium-sized Medical Center Library

By Robert M. Braude, *Associate Librarian*

Nancy Holt, *Cataloger*

Denison Memorial Library, University of Colorado Medical Center
Denver, Colorado

ABSTRACT

The need for a cost-performance analysis of TWX-mediated versus mail-mediated ILL requests is presented. Three hypotheses are proposed: (1) Unit cost for TWX-mediated ILL requests is greater then for mail-mediated ILL requests; (2) Completion time is shorter for TWX-mediated ILL requests than for mail-mediated ILL requests; (3) An analytic model can be developed that can be used to generate administrative data concerning a TWX installation. The data presented support all three hypotheses. It is shown, also, that through the use of this model a library can arrive at a cost for service of TWX versus mail-mediated ILL.

THE use of TWX in libraries, primarily for interlibrary loan (ILL) operations, is not a new phenomenon. Because of its relatively low cost and ease of operation, libraries have viewed TWX favorably and have made use of it as a part of the ILL network that has existed for more than twenty years. In recent years the emphasis on TWX has grown in the medical library community primarily due to stimulation of interlibrary cooperation by federal programs. Both the Regional Medical Program and the Regional Medical Library Program have created a demand for greater sharing of resources among libraries and for a more rapid information delivery system. The use of TWX has been identified as an essential part of this new regionalization of information resources, and most libraries have asked for support of TWX installations in their grant proposals to the federal government.

In spite of the increased reliance on TWX as the medium for rapid communication of ILL information and the rapid proliferation of TWX installations in medical libraries, the literature is almost devoid of information concerning either the cost or the performance of TWX in the ILL operation. Poole (1) in 1966 published a literature survey of TWX applications in libraries. He was able to recover less than forty articles from 1951 to the date of his report and most of the articles contained little or no information concerning cost. More recently, an article by Bird (2) gives average costs per message for six libraries participating in a local TWX network. Since the data used for estimating the cost are not given, it is not known whether the cost reflects only rental and line charges for the TWX or includes all costs related to a TWX-mediated ILL. Bird also points out, without showing supporting statistical evidence, that a definite improvement was realized among the six libraries in their ILL operations. This factor of increased speed in ILL has always been an underlying assumption in any TWX installation.

In this present day, when funds are limited and demand for increased services continues to grow, it is important to have objective evidence that can back up intuitive statements concerning service. It is the purpose of this paper to try to apply standard analytical techniques to the area of TWX-mediated ILL in order to determine what the exact cost and true performance is. It is hoped, as well, that a model analysis can be developed that can be used by other libraries in replication and validation of the conclusions presented here.

Three hypotheses are proposed: Unit cost for TWX-mediated ILL is higher than for mail-mediated ILL; completion time for TWX ILL is shorter than for mail ILL; and an analytic model can be developed that can be used to generate administrative information concerning a TWX installation for ILL activity.

METHOD

The data used for the study were the out-of-state ILL requests originated by the Denison Memorial Library over the three-year period, July 1966–June 1969. The out-of-state requests were used because the Denison Memorial Library is the only Medical Center library in Colorado. For those requests going to the university libraries in the surrounding area a courier service is used. In order to present a true picture of both use and time, the out-of-state sample was selected. The year July 1966–June 1967 consists of mail requests only since the TWX had not yet been acquired. (An ASR 33 TWX was installed in July 1967.) This pre-TWX year was analyzed as a control year to determine what effects, if any, the TWX installation had on post-TWX mail requests and to determine whether completion times would vary systematically in the subsequent years.

It is important to note that what is being analyzed is transmission time only. It is the purpose of this study to determine differences in cost and completion times for that part of the ILL operation that concerns borrowing. No attempt was made to figure in the time necessary to determine what the nature of the request is, to verify it, and to determine locations. The study analyzes that part of the borrowing operation that begins with a complete and verified request that must be sent to some particular location.

Unit cost was calculated according to the procedure given in Dougherty (3) with the exception that overhead costs were not calculated since they are approximately equal for both methods of ILL transmission. True labor costs were calculated on the basis of personnel costs adjusted for sick-leave, holidays, vacations, institutional benefits, and time for personal needs. An average time for typing ALA ILL forms and for preparing the TWX message was determined from timed observations. (The average time for preparing a TWX message was found to be 2.9 minutes and for the ALA form 2.0 minutes. The time for typing the ALA form is very close to that reported by Cruzat (4), 1.8 minutes, in her study of ILL operations at Wayne State University.) Time for each type of request was calculated and multiplied by the labor costs to get unit labor cost. The TWX line charges (variable) were divided by the total number of ILL messages sent via TWX and that cost plus the unit labor cost made up the direct unit cost of the TWX operation. The initial installation cost plus supplies cost and monthly rental, $60.00, was divided by the number of TWX requests to give the indirect unit cost per loan. Postage charges, cost of ALA forms, cost of envelopes, and unit labor cost for typing a request were computed for mailed requests to determine the total unit cost.

Completion times were calculated from the actual TWX copy or the ALA form. The date sent and the date received were used to determine the number of days for completion of each request. The mean number of days for both mail and TWX requests was calculated. Since not every completed request had both dates noted, the sample size used for calculating mean days for completion is slightly smaller than the sample size used for the calculation of unit cost. The TWX sample used for calculation of completion times was 91 percent of the total completed TWX messages and the sample for mail completion times was 40 percent of the total completed mail requests.

TABLE 1

UNIT COST FOR TWX AND MAIL ILL REQUESTS COMPLETED REQUESTS

TWX SAMPLE SIZE = 1,137

	DIRECT COST		INDIRECT COST	TOTAL
	Labor	Line Costs/ Postage	Installation; Supplies; Rental	
TWX.....	$0.239	$0.704	$1.378	$2.321
Mail.....	$0.125	$0.06	$0.029	$0.214

RESULTS

Unit cost data for completed TWX and mail requests is shown in Table 1. It is obvious that the TWX is a considerably more expensive way to transmit ILLs. In the table, however, all TWX-mediated ILL costs are directly charged to just those requests that were completed. Table 2 shows the unit cost for transmitting all TWX messages for ILL regardless of whether or not the response was positive or negative. The total unit cost is higher in Table 1 because the costs of transmitting more

than one message in order to complete a transaction must be distributed among the number of actual completed requests.

The data concerning completion time is presented in two ways. Fig. 1 illustrates the variation by year of observation on mean completion time for each mode of transmission. It also illustrates the effect of the TWX installation on the completion time for mail requests. In Fig. 2 the cumulative percent completed is plotted against the number of days for completion for each mode of transmission. The ogives that are produced can be used not only for a comparison of past performance but also for predicting future performance.

The curves in Fig. 2 for the TWX requests and the post-TWX mail requests represent the average completion rate over the two post-TWX years. No statistically significant difference between the two years for either the TWX or the mail samples was found at the .05

TABLE 2

UNIT COST FOR TOTAL TWX ILL MESSAGES
SAMPLE SIZE = 1,496

DIRECT COST		INDIRECT COST	TOTAL
Labor	Line Costs	Installation; Supplies; Rental	
$0.182	$0.535	$1.047	$1.764

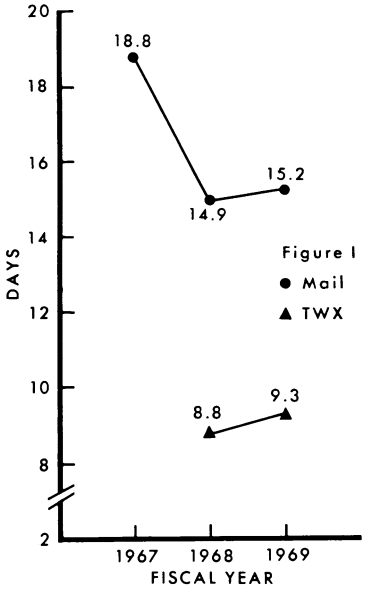

FIG. 1.—Variation by year of observation on mean completion time. Fiscal Year 1967 is the pre-TWX control year. Sample sizes: 1967 = 492, 1968 TWX = 460, 1968 mail = 229, 1969 TWX = 585, 1969 mail = 136.

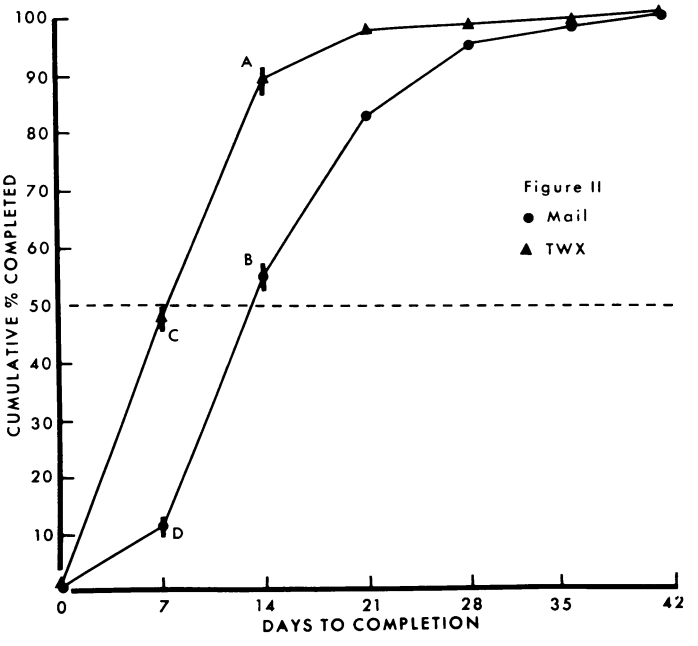

FIG. 2.—Cumulative distribution of per cent completed. Sample sizes: Mail = 365, TWX = 1,045. Reference points: A = 87%, B = 55%, C = 48%, D = 11%.

level of confidence using the Kolmogorov-Smirnov test, Siegel (5).

Discussion

In examining the cost data it is important to note several factors. It is obvious that the unit cost should decrease as the volume of activity carried on the TWX increased. This would be due to a unit decrease in the indirect costs. Another factor in the unit cost reported here was the procedure of charging the full monthly rental, supplies cost and installation cost to only ILL transactions. This procedure maximizes unit cost for ILL and is not necessarily valid in a normal operating environment. Even if the TWX is installed primarily for ILL activity it has other uses in the library. It can serve for transmission of reference questions in a regional operation and for various administrative functions as well. It seems reasonable to attribute only a proportion of the indirect costs to the ILL function which would result in a lowering of the unit cost for ILL. In the sample used here approximately 10 percent of all TWX messages were not related to ILL activity. If 10 percent of the monthly rental and other indirect costs is subtracted the unit cost for completed and total ILL requests is $2.182 and $1.659 respectively.

It would also be possible to attribute part of the indirect costs to the total activity of the TWX which would include messages received. When a library installs a TWX, that installation is valuable to other libraries having TWX since it increases the total volume at each TWX installation. Since increased volume reduces unit cost the availability of one library's TWX is valuable to all other libraries' TWX. This kind of analysis is theoretical insofar as it does not lower the total cost to any one library. It does, however, allow for a more meaningful allocation of cost between any library's individual usage and total usage throughout a network. Statistics on incoming TWX messages were not recorded during the two-year period sampled so this factor could not be studied at this time. It would seem useful to apply this type of analysis at some later date when the Regional Medical Libraries are further along in their development. The data presented by Bird (2) would seem amenable to this type of analysis and his study might be worth repeating to get a truer cost picture of a regional TWX network.

Unit cost is only half of the picture and in order to evaluate TWX, it is necessary to balance this against performance. The two major aspects of performance are completion time and users' need. It is clear from the data presented that there is a significant decrease in completion time (average decrease = one week) which is directly attributed to the TWX. It is also clear that, at least over the two years studied, this significant difference is stable. The reduction in completion time for mail requests after the TWX installation is somewhat harder to evaluate. The difference is apparently real and since the mean completion time for mail requests in the two post-TWX years is relatively stable it seems reasonable to attribute the reduction in completion time between 1967 and 1968/69 to the installation of the TWX. Why this is so cannot be positively stated. One explanation may be related to the use of the TWX itself. It is reasonable to assume that a library with a TWX would contact another library with TWX as a first choice with any request. When the mails are used the first choice is usually the nearest library. If the nearest libraries do not have TWX then they will evidence a reduced workload in mail requests due to the borrowing library's choice of the TWX mode of transmission and therefore would be able to offer faster service. Another possible explanation is that this reduction in completion time may be a purely accidental one. Along with the increase in TWX installations there has been an increase in the development of union lists. One of the effects of union lists is to distribute the pattern of ILL borrowing over a greater number of libraries. The obvious effect of this pattern is to reduce the volume at any one library thus resulting again in faster service.

In examining the difference in completion time for TWX-mediated versus mail-mediated ILL requests several factors must also be considered. In spite of the long history of TWX utilization, there is obviously some novelty effect at work that contributes to the increased speed of TWX-mediated requests. Many libraries have adopted the procedure of filling all TWX requests first and then filling mail requests. This procedure will both decrease TWX request times and increase mail request

times. The period investigated may be too short to account for a lessening of this novelty effect and perhaps a study of the next two years would show an increase in completion time for TWX requests. The apparently slight increase in TWX completion time for 1969 (see Fig. 1) might be an indication of this lessening of the novelty effect, although the difference is not great and not statistically significant.

Besides novelty effects there are other uncontrolled variables influencing TWX completion times that are difficult to analyze. Attributing a higher priority to a TWX request by the lending library might be one; individual differences between those libraries that have TWX and those that do not might be another. These types of variables will probably always remain in any study of TWX performance, but their influence should be reduced as the number of TWX installations increases and as a function of time.

The other factor that must be considered in examining performance for TWX-mediated requests is the needs of the user himself. It is important to consider his absolute time requirements, when they can be objectively estimated, in order to determine the level of service that is being given. It makes little difference if the use of TWX enables the library to complete a transaction in seven days if the user needs the material in six. An example from the data presented here is worth considering. If all requestors had a two-week time limit on their request, then the TWX method would have been 87 percent successful in meeting this need whereas the mail method would have been only 55 percent successful. (Fig. 2 points A and B). If, however, the requestors had a seven-day time limit, the per cent of success for the TWX and mail methods would have been 48 and 11 respectively. (Fig. 2 points C and D). While it can be stated from these data that the use of TWX speeds up ILL transactions it is not unequivocal that the increase results in better service in the ILL operation. It may be necessary to elicit time limits from the requestor along with his request in order to judge truly the performance of the ILL operation in any library.

The performance data gathered in this study, however, do provide some predictive information for this library and perhaps for others, insofar as the library studied is typical of those libraries engaged in the same operations. An example of the predictive value of the data can be demonstrated.

If a requestor wanted an item in seven days it is clear from the data that there is a 48 percent chance of obtaining it if the TWX can be used. There is only an 11 percent chance if the mails are used. If no time limit were stipulated then either method could be used. If the library were to sample the time requirements of its users and determine that the mean time requirement was fourteen days then it is clear it would be necessary to have TWX in order to provide satisfactory service. On the other hand, if the library were to set an arbitrary service goal of completing 50 percent of its transactions in two weeks or less the method that best meets this goal could be determined from the curve; in this case either method would satisfy that goal.

Performance and cost are not separable in library operations and it is important to cost justify a given type of activity for any library. Again the data presented here can be used. In the example given above of a two-week completion time requirement *by the requestor*, the cost of TWX is justified in that it is the only method that can reasonably satisfy the need—87 percent completed via TWX, 55 percent completed via mail. If the goal of 50 percent fulfillment of ILL requests in two weeks or less is chosen *by the library* then the TWX is not justified. It is possible, by using this type of data, for the library to set whatever goal it feels is necessary to meet the service requirements desired and then to determine which of the two methods will satisfy those requirements. In this way the library can cost justify its selection and know just what it is paying for the service and consequently how much that service is worth.

Conclusions

If the initial hypotheses are evaluated in light of the data presented, then all must be accepted. The unit cost for TWX-mediated ILL's is indeed greater than the unit cost for mail-mediated ILL's, although means of reducing the TWX cost have been presented. The completion time for the TWX requests is considerably shorter than for mail requests. The final hypothesis, that of developing an analytic model for the study of TWX in ILL, must also be accepted. The curves developed are useful in allowing a library to determine what its past level

of service has been and what different levels of service might be expected with each mode of transmission. When these data are coupled with the unit cost data the library has at last arrived at the point where it can put a price on service.

What seems desirable at this time is replication of this method of analysis at other libraries. It would be interesting to know if the data reported here were typical of most library ILL operations or unique to this one situation. The method used here is not tied to any unique characteristics of this library and should be valid when applied to a cost-performance analysis of any ILL operation. The curves that are generated will be useful not only in validating those given in this study but also for their predictive value to each library that does the analysis.

REFERENCES

1. POOLE, HERBERT. Teletypewriters in libraries; a state of the art report. Coll. Res. Libr. 27: 283–286, 290, 1966.
2. BIRD, WARREN. TWX and interlibrary loans. Bull. Med. Libr. Ass. 57: 125–129, 1969.
3. DOUGHERTY, RICHARD M., AND HEINRITZ, FRED J. Scientific Management of Library Operations. New York, Scarecrow Press, 1966. 258 p.
4. CRUZAT, GWENDOLYN S. An evaluation of the interlibrary loan service; Wayne State University Medical Library. IV. Determination of cost for processing interlibrary loans, borrowing operation. Detroit, Wayne State University School of Medicine Library and Biomedical Information Service Center. Report no. 29, 1967. 12 p.
5. SIEGEL, SIDNEY. Nonparametric Statistics for the Behavioral Sciences. New York, McGraw-Hill, 1956. 312 p.